

Planting Winter Wheat in Dry Soil

Alexander D. Pavlista, Extension Specialist, Crop Physiologist
Dipak K. Santra, Alternative Crops Breeder

It's September and the soil may be too dry to plant winter wheat. What can you do? This NebGuide will discuss your options, their advantages and disadvantages.

Is the Topsoil Dry?

Is the soil moisture adequate to plant winter wheat? That is the first question to ask. You need to determine whether there may be a problem for planting in September. First, check the weather for August. In Nebraska, check with the High Plains Climate Center managed by the University of Nebraska–Lincoln and look at rainfall. Rainfall can vary greatly between years and locations (*Table 1*). Compared to the previous two years, 2012 had a severe drought in August that continued into September. This is a good initial indication that the soil is dry, but it is not a real measure of it.

A simple estimate for measuring soil moisture is the “appearance and feel” method. This method estimates soil moisture in 25 percent increments of available moisture, but it requires some experience (see NebGuide G84-690, digitalcommons.unl.edu/).

A more accurate method to estimate soil moisture is the gravimetric method. This is a simple procedure requiring a soil probe, a scale, and a drying oven. To determine soil moisture availability for seed germination, take several core samples from around where the seed will be planted, a couple of inches above and below the seed depth. To determine whether there is sufficient soil moisture to ensure a decent crop of grain, samples need to be taken to a depth of 4 to 5

feet (see NebGuide G1740, Guidelines for Soil Sampling, www.ianrpubs.unl.edu/sendIt/g1740.pdf).

Put each sample in a labeled, sealed bag. Pour the soil from each sample onto a weigh pan and weigh (fresh weight); afterwards, place pan in a drying oven set between 250 and 300°F for a week. Remove the soil samples from oven and weigh (dry weight) again. Don't forget to tare the scale for the weight of the pan. Soil moisture is calculated:

$$(\text{fresh weight} - \text{dry weight}) \div \text{dry weight}$$

Multiply the resulting fraction by 100 to get the percent soil moisture of the top 8 inches. If the soil moisture is calculated to be between 16 and 20 percent, you are all right, but if the calculation is less than 12 percent, there is a severe, probably below wilting point, deficit and the soil is very dry.

What are the Options?

There are three basic options (see Planting Winter Wheat into Dry Soil, at igrow.org/agronomy/wheat):

1. **Plant normally and hope for rain.** Two unwanted results could occur: crusting after a hard rain and soil erosion due to strong wind (see NebGuide G1740, Wind Erosion and Its Control, www.ianrpubs.unl.edu/sendIt/g1740.pdf). Crusting is less likely in no-till situations than in conventionally tilled fields.
2. **Wait for rain, then plant.** Treat operation as late seeding and increase seeding rate — that is plant density — to

Table 1. Rainfall (inches) in August and September in 2010, 2011, and 2012 in western and south central Nebraska (High Plains Climate Center, Lincoln).

	August			September		
	2010	2011	2012	2010	2011	2012
Alliance	1.9	1.4	0.1*	0.7	0.3	0.5
Sidney	1.4	1.8	0*	0*	1.2	0.5*
North Platte	2.1	2.1	0.4*	1.6	0.9	0.1*
Kearney	1.9	3.1	1.2	0.1*	0.6*	0.5*

*indicates that rainfall was less than 30 percent of normal.

compensate for possible plant loss (see NebGuide G2056, Seeding Rates for Winter Wheat in Nebraska, www.ianrpubs.unl.edu/sendIt/g2056.pdf).

3. **Seed deeper to reach water.** This will require seedlings to grow through more soil to emerge and absorb sunlight. Therefore, seeding a variety with a long coleoptile (first leaf sheath) is preferable. Since there may be plant loss, increasing the seeding rate should be considered (see Planting Winter Wheat into Dry Soil, University of Wisconsin, ipcm.wisc.edu/blog/2012/09/planting-winter-wheat-into-dry-soil/).

Choosing a Planting Date

Planting early has several risks, and yields tend to be depressed (*Figure 1*). Plants may be too large and thereby have lower winter hardiness, longer exposure to diseases (see Compendium of Wheat Diseases published by the American Phytopathological Society), and greater competition between tillers because of increased tiller number before winter.

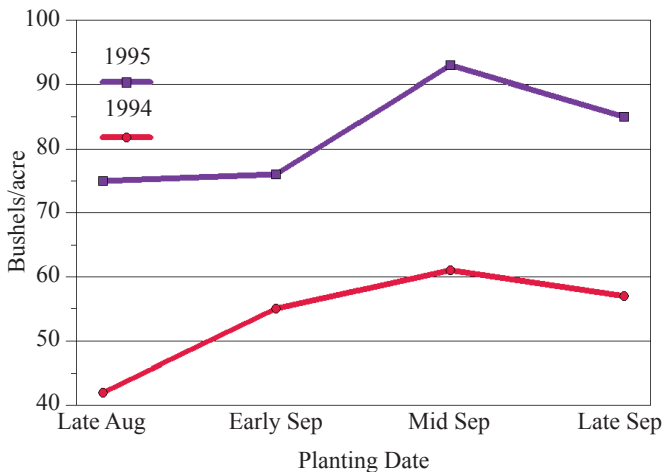


Figure 1. Grain yield as affected by early planting at Sidney, Neb. (modified from Lyon, et al. 2001. Wheat grain and forage yields are affected by planting and harvest dates in the central Great Plains. Crop Sci. 41:488-492)

There also are risks associated with planting late, and yields also can be depressed (*Figure 2*). Plants may be smaller; therefore, they would be more susceptible to winter kill and to soil erosion. Pest exposure would be decreased. Since there would be fewer tillers, seeding rate should be higher.

What can you do as a safety measure in case rain does not come before winter? Should you plant deeper, use a higher seeding rate, and/or apply gibberellic acid— a stem growth stimulant?

Seeding Rate

The recommended seeding rate for soils with acceptable soil moisture is 18 seed per linear foot in 6 to 8 inch rows, and plant population densities (PPD) would be 1,570,000 and 1,180,000 seed per acre in 6- and 8-inch rows, respectively. However, the recommendation for planting in dry soil is to lower the PPD by planting in wider rows and keeping the

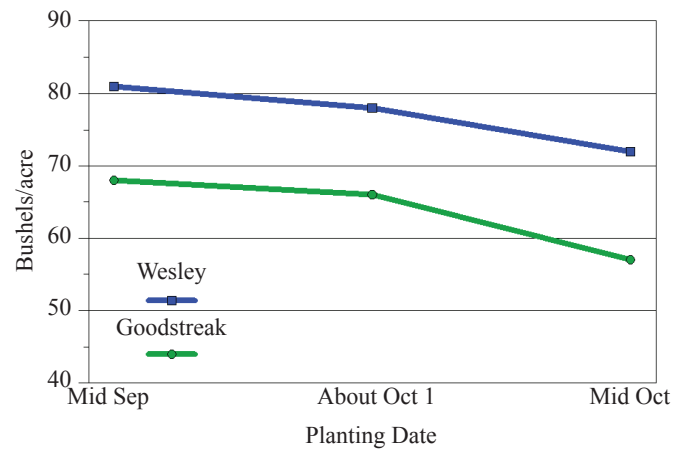


Figure 2. Grain yield as affected by late planting at Scottsbluff, Neb. (Pavlista, unpublished data, five-year means from 2006 to 2010)

in-row population at 18 seeds per linear foot. This results in about a 40 percent decrease in PPD or 940,000 and 670,000 seed per acre for 10- and 14-inch rows, respectively. *It is critical to note that this is seeds per acre, not pounds or bushels per acre*, as seed has different weight depending on variety, harvest year, and location (see NebGuide G2056, Seeding Rates of Winter Wheat in Nebraska, www.ianrpubs.unl.edu/sendIt/g2056.pdf). Heavier seed results in fewer seeds per pound or bushel, and vice versa. To determine the weight of seed to plant, weigh three 1,000-seed samples in pounds (or if in ounces, remember to divide by 16 to calculate pounds). Divide 1,000 by the average 1,000-seed sample weight to calculate the number of seed in a pound (*Table II*). Do this for each seed lot. Certified seed bags have a percent germination on the tag that should be used to estimate the number of viable plants to emerge. To calculate this, divide the seed number per pound by the fractional germination. For example, 85% germination = 0.85 fractional germination (*Table III*).

Table II. Examples of converting seed/lb to lb seed/acre for plant population density (PPD), maintaining 18 plants/linear foot at four row spacings.

Row spacing	6 inch	8 inch	10 inch	14 inch
PPD* (million seed/acre)	1.570	1.180	0.940	0.670
number of seed/lb	----- lb seed /acre -----			
10,000	157	118	94	67
12,000	131	98	78	56
15,000	105	79	63	45
18,000	87	66	52	37

Table III. Examples of converting 100 lb seed/acre to lb viable seed/acre after calculating seeds/lb desired.

lb seed /acre	Percent Germination				
	75	80	85	90	95
	----- lb viable seed /acre -----				
60 lb	80	75	71	67	63
90 lb	120	113	106	100	95

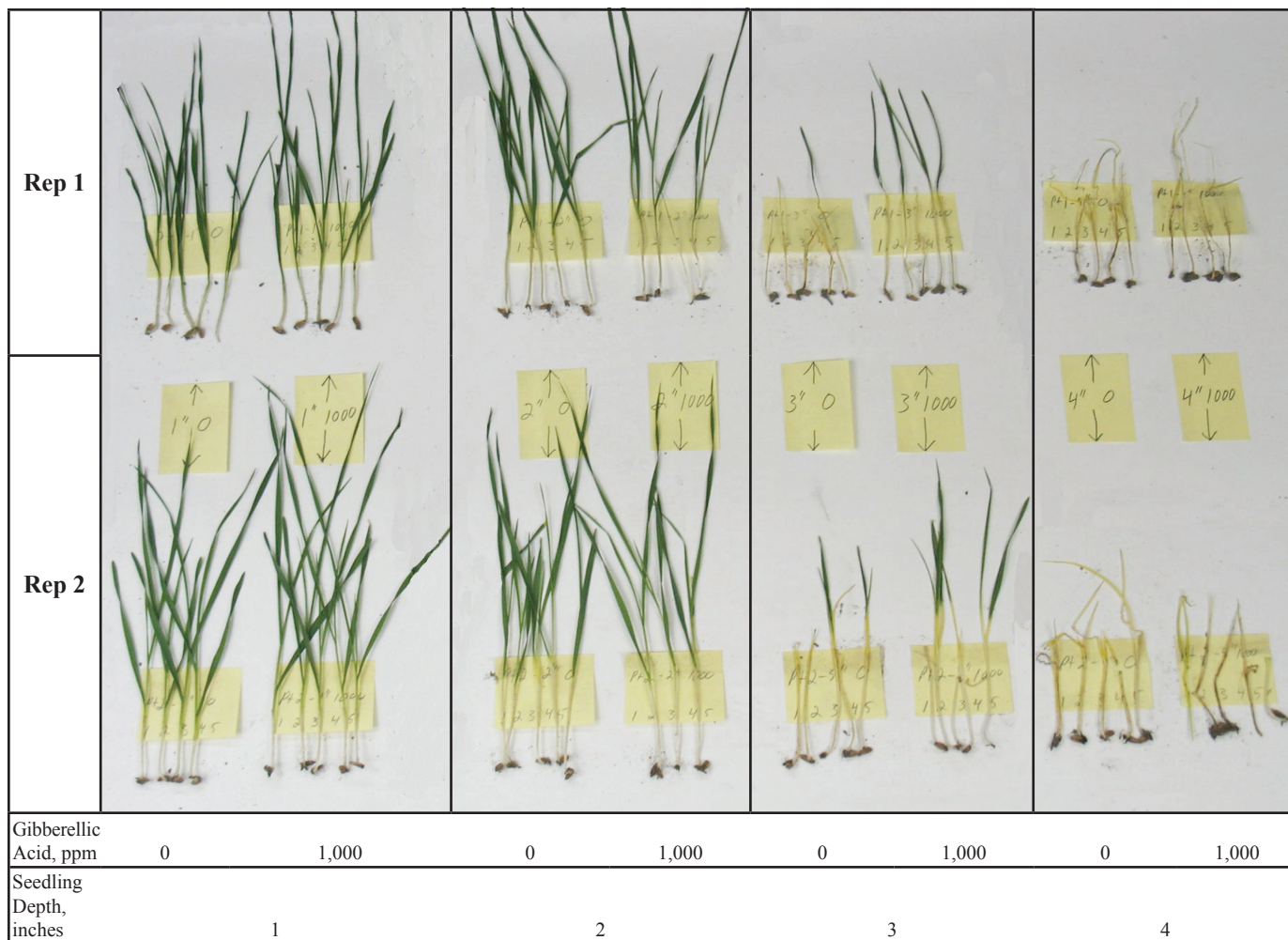


Figure 3. Wesley plants, three weeks after planting, from seed planted at 1 to 4 inches deep, treated with 0 (control) or 1,000 ppm gibberellic acid.
Click on image to make larger.

There are risks associated with low as well as high PPD. If PPD is too low, there will be a higher water loss from the soil, increased tiller formation resulting in high competition between them, and small seed and lower yields. If PPD is too high, there will be a higher water loss from plants, more plants resulting in more competition, and fewer heads and lighter kernels. Wheat has a very plastic morphology; that is, it can adjust tiller number, seed number, and seed size according to its environment. This allows yield to be similar over a wide range of PPD.

Seeding Depth

For planting in dry soil, the recommendation is to seed to a depth of 3 inches in order to reach soil water that may exist further below the surface. However, the primary risk is low emergence. With the seed buried deeper, the coleoptile has a longer distance to grow. The length of the coleoptile is related to the genetics of the variety. Wesley, a high-yielding, semi-dwarf variety, has a short coleoptile. Goodstreak, a tall variety, has a longer coleoptile. Consequences from planting deep have been delayed emergence, premature leaf exposure underground, fewer tillers formed, and the dangers of soil compaction. There are steps you can take to try to mitigate these risks:

- Choose a variety with a long coleoptile to extend through soil; however, these varieties tend to yield less than semi-dwarfs.
- Treat seed with gibberellic acid, a natural growth promoter, to promote emergence and growth. See Using Gibberellic Acid (GA3) below.
- Increase PPD by planting in narrower rows (see Seeding Rate on page 2) to compensate for fewer tillers. If that is not possible due to equipment limits, increase seeds per linear foot.
- Use no-till or reduced till practices to minimize soil compaction.

Using Gibberellic Acid (GA3)

Gibberellic acid is a growth promoter that stimulates stem elongation and is found in all vegetation, including wheat. In a growth chamber trial, Wesley seeds were planted in dry HPAL soil at depths of 1 to 4 inches. Half of the seeds were treated with water and half were treated with 1,000 ppm GA3. The resulting Wesley seedlings after three weeks are seen in *Figure 3*. GA3 improved emergence, plant height, leaf number, and plant weight of seeds planted 3 inches deep (*Figure 4*). At HPAL, a

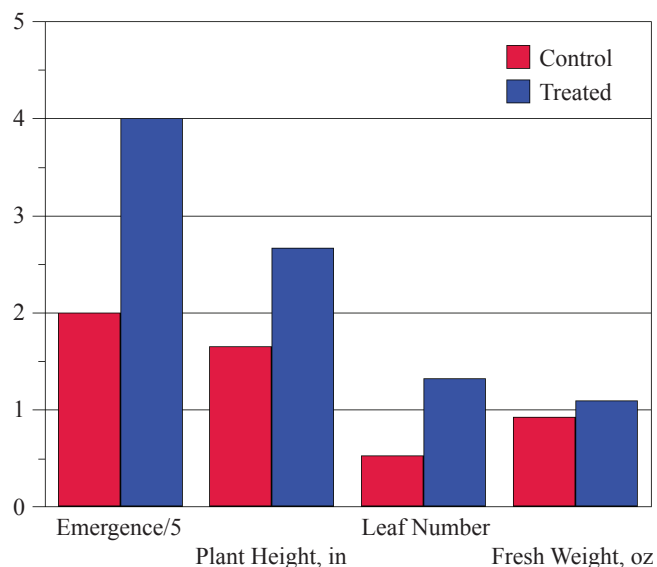


Figure 4. Growth parameters, three weeks after planting seed 3 inches deep with and without 1,000 ppm gibberellic acid (Pavlista).

field trial was conducted comparing treated and untreated Wesley seed planted 3 inches deep in dry soil. Treated seed showed greater growth and had a better appearance than untreated plants. These tests were only conducted with Wesley but irrigated growth chamber tests showed that all 12 varieties tested responded to GA3 and, in general, 1,000 ppm GA3 is needed for semi-dwarf varieties for maximum effect and 500 ppm for tall varieties. Field trials comparing Wesley and Goodstreak came to the same conclusion.

If All Else Fails?

A last option is to plant a spring crop such as camelina, canola, and fenugreek, or a summer crop such as proso millet, sunflower, or corn.

Conclusion

The major steps to consider in planting winter wheat in dry soils are to plant later in September or early in October, to plant in narrower rows and/or use higher seeding rates, to plant deeper up to 3 inches, and to plant seed treated with gibberellic acid to promote growth. All of these have associated risks and risk mitigation.

This publication has been peer reviewed.

UNL Extension publications are available online at <http://extension.unl.edu/publications>.

**Index: Crop Production
Wheat**

Issued September 2013

Extension is a Division of the Institute of Agriculture and Natural Resources at the University of Nebraska–Lincoln cooperating with the Counties and the United States Department of Agriculture.

University of Nebraska–Lincoln Extension educational programs abide with the nondiscrimination policies of the University of Nebraska–Lincoln and the United States Department of Agriculture.

© 2013, The Board of Regents of the University of Nebraska on behalf of the University of Nebraska–Lincoln Extension. All rights reserved.